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Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, September 2020

(2013 Scheme)

13.704 : REFRIGERATION AND AIR CONDITIONING (M)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. Each question carries **2** marks.

Steam tables permitted.

1. Describe vapour refrigeration system.

2. Draw T-S diagram for simple boot strap refrigeration system.

3. What is meant by one tonne of refrigeration?

4. What is meant by flash gas removal in refrigeration system.

5. What is superheating process? Draw the PV diagram for the same.

6. Write the functions of condenser in refrigeration system.

7. How the vapour compression refrigeration system works? Draw the T-S diagram to represent vapour compression process.

8. Define by-pass factor.

9. Give the short note on working of year round air-conditioning system.

10. Write some industrial applications of air-conditioner?

(10 × 2 = 20 Marks)

P.T.O.

PART – B

Answer **any one** from **each** Module.

Module – I

11. (a) Explain with neat sketch working of regenerative air-conditioning system with its T-s diagram. **10**

(b) A simple air cooled system is used for a aeroplane having the load of 9 TR. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. During ramming pressure increases to 1.013 bar. In the heat exchanger the temperature of air is reduced by 55°C . The pressure in the cabin is 25°C find, **10**

(i) Power required to take the load of cooling in the cabin

(ii) COP of the system.

12. (a) A bootstrap cooling system of 9 TR capacity is employed in an aeroplane . The ambient air temperature and pressure is 20°C and 0.86 bar respectively. The pressure of air increases from 0.86 bar to I bar due to ramming action of air. The pressure of the air discharged from the main compressor 3.2 bar. The discharge pressure of air from the auxiliary compressor is 4.2 bar. The isentropic efficiency of each compressor is 82%, while that of turbine is 86 %. 45% of the enthalpy of air discharged from the main compressor is removed in the first heat exchanger and 32 percent of the enthalpy of air discharged from the auxiliary compressor is removed in the second heat exchanger using rammed air. Assuming ramming action to be isentropic the required cabin pressure of 0.92 bar and temperature of the air leaving the cabin not more than 21°C, find

(i) The power required to operate the system T-s **10**

(ii) COP of the system.

Take C_P of air = 1 *kJ/kgK*, $\gamma = 1.4$

(iii) Draw the schematic and temperature specific entropy diagrams.

(b) A Bell-Coleman cycle works between 1 bar and 5 bar. The adiabatic efficiency of the compressor is 85 % and expansion is 90%. Find the COP of the system and its tonnage when the air flow rate is 1 kg/sec. The ambient temperature is 27°C and refrigerator temperature is 0°C. **10**

Module – II

13. (a) Briefly explain in detail about the methods of improving COP for a multi evaporator system. **10**

(b) Explain the cascade refrigeration system with neat sketch and state its advantages. **10**

14. (a) The vapour compression system is used to maintain a temperature of- 23°C in a refrigerated space. The ambient temperature is 37°C. The compressor takes dry saturated vapour of F_{-12}. A minimum 10°C temperature difference is required at evaporator as well as condenser There is no sub-cooling of liquid. If the refrigerant flow is 1 kg/min, Draw TS and PH diagram for the given data, and find

(i) Tonnage of refrigeration.

(ii) Power requirement

(iii) Ratio of COP of this cycle to COP of Carnot cycle **10**

(b) An ammonia refrigerator works between – 20°C and 30°C. The vapour is being dry at the end of isentropic compression. Assuming there is no subcooling, Find

(i) Theoretical COP

(ii) Power of the motor to run the compressor to absorb 100 MJ/hr. Use the following properties for NH_3. **10**

$Temp^oC$	$h_f(kJ/kg)$	$h_g(kJ/kg)$	$s_f(kJ/kg-K)$	$h_f(kJ/kg-K)$
30	562	1712	4.69	8.48
-20	328	1661	3.83	9.12

Module – III

15. (a) Draw and explain the neat diagram of Electrolux refrigerator with its working principle? What is the important role of Hydrogen in this refrigeration system. **10**

(b) Discuss briefly about the various methods used for capacity control of a reciprocating air compressor. **10**

16. (a) Explain briefly about the factors which affect the heat transfer capacity of an evaporator. **10**

(b) Derive a expression for find out the mass of motive steam requires per kg of water vapour produced. **10**

Module – IV

17. (a) Explain with neat sketch and describe

(i) Psychometric process

(ii) Humidification process. **10**

(b) Explain with neat sketch the working of window air-conditioner. **10**

18. It required to design an air-conditioning system for a restaurant with the following data

Inside design conditions	$24^{\circ}C\ DBT, 55\%RH$
Outdoor conditions	$39^{\circ}C\ DBT, 28\%WBT$
Infiltrated air	$16 m^3/\text{min}$
No of occupants	30
Sensible heat gained per person	60 W
Latent heat gained per person	60 W
Internal lighting load	20 lamps of 100 W. 12 fluorescent tubes of 60 W
Solar heat gain through walls, roof and floor	6.1 kW
Solar heat gain through glass	5.6 kW
Sensible heat gain from other sources	12.2 kW
By-pass factor of the coil	0.2

If 25 percent fresh air and 75 percent re-circulated air is mixed and passed through the conditioner coil, Determine

(i) Amount of total air required in m^3/hr

(ii) Dew point temperature of coil

(iii) Condition of supply air to the room, and

(iv) Capacity of the conditioning plant. **20**

(4 × 20 = 80 Marks)
